

Cover Page

An application submitted for projects in the Florida Keys National Marine Sanctuary:

Project Title: Monitoring Water Quality in the Key West Ship Channel and surrounding ecologically and culturally significant coral reefs pre- and post-COVID-19 Anthropause.

Principal Investigator(s): Dr. Patrick Rice (The College of the Florida Keys); Dr. Henry Briceño (Florida International University)

Date Submitted: July 26, 2021 **Proposed Start Date:** January 1, 2022

Total Federal Funding Request: ____ \$299,968 ____

We, the undersigned, certify that, in the event this application is accepted whole or in part, our signatures on this application constitute intended acceptance of and compliance with applicable policy, rules, and regulations of the U.S. Environmental Protection Agency.

ENDORSEMENTS:

Submitted by:
Principal Investigator



Digitally signed by Dr. Patrick Rice
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Signature

Patrick H. Rice, Ph.D.
Typed Name

Chief Science & Research Officer
Title

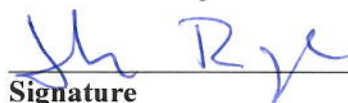
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Project Summary

There is global anecdotal evidence suggesting that coastal water quality indexes (e.g. turbidity) have improved during the COVID-19 anthropause (i.e. the lack of human activity), including the waters around Key West, Florida. Previous efforts to measure the water quality started in fall 2020 during marine science courses at the College of the Florida Keys (CFK) and increased in scope and frequency during the spring and summer of 2021. These efforts indicated good water quality characterized by low turbidity, high DO, and zero hydrogen sulfide. There is growing concern that the return of human activity or climactic events will disturb these conditions and potentially impact nearby ecologically sensitive areas like Eastern Dry Rocks – Sanctuary Preservation Area (EDR). However, previous efforts represent a minimum of monitoring, leaving gaps in coverage which could miss perturbations in the water quality and connectivity between EDR and the Key West Harbor/ship channel during the post-anthropause period. Therefore, the current proposal intends to expand the scope by: (1) deploying more water quality monitoring equipment to create an array of monitoring stations between EDR and the Key West Harbor/ship channel that will measure water quality, (2) increase the scope and frequency of field measurements employing CFK marine science students and courses, (3) increase the scope and frequency of water sampling for laboratory analysis for important water quality metrics by project partner Florida International University, and (4) deploy an autonomous underwater vehicle (AUV) to measure important water quality metrics immediately before and after large ships enter the port of Key West, FL. The funded project will last for one year but will be sustained by CFK as part of the marine science curriculum in perpetuity while the equipment remains functional. The results will be presented at appropriate conferences, published in technical reports to EPA, and peer reviewed journals as warranted.

Project Title: Monitoring Water Quality in the Key West Ship Channel and surrounding ecologically and culturally significant coral reefs pre- and post-COVID-19 Anthropause.

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1. Introduction:

a. *Situation, Need, and Previous Efforts:*

There is global anecdotal evidence suggesting that coastal water quality indexes (e.g. turbidity) have improved during the COVID-19 anthropause (i.e. the lack of human activity). In Key West, Florida, the lack of shipping traffic has been suggested as the primary reason for the perceived improvements to water quality during the COVID-19 Anthropause. The assumption is that less ship traffic results in less sediment re-suspension due to prop wash excavation (Murray & Associates, 2005). In a recent report based on 25+ years of water quality measurements and remote sensing data near Key West, FL, Briceño (2021) found that water quality improved (i.e.

turbidity decreased while dissolved oxygen increased) during the recent anthropause. However, no measurements were taken in the Key West Harbor or within one mile of the shipping channel (a.k.a. navigation channel). Moreover, field samples focused on proven water quality indicators including turbidity, dissolved oxygen, and light attenuation coefficient (K_d) but did not test for other less common, yet critically important substances like hydrogen sulfide. Hydrogen sulfide (H_2S) could have elevated importance during the transition from the anthropause to normal human activity (hereafter referred to as the “transition”) as subsurface sediments, which have not been disturbed for over a year, are resuspended into the water column by the onset of human activity. H_2S is highly toxic to marine organisms and causes rapid depletion of dissolved oxygen (DO) in marine waters (Asaoka et al., 2009). Finally, coral reefs proximal to the Key West shipping channel are most vulnerable to changes in water quality due to the transition. Of special importance is the patch reef at Eastern Dry Rocks Sanctuary Preservation Area (EDR-SPA), which has been identified by the Florida Keys National Marine Sanctuary (FKNMS) as one of seven “ecologically and culturally significant coral reefs” (www.fisheries.noaa.gov/iconic-reefs) approximately 3.5 km west of the entrance to the Key West Shipping Channel.

Previous efforts: During the fall 2020 and spring 2021, the College of the Florida Keys (CFK) conducted basic water quality analysis for dissolved oxygen (DO), temperature, and secchi depth, at three depths (surface, mid-water, max-depth) in the Key West Harbor/ship channel as field labs for the course OCB 2102C Marine Data Collection. Results indicated oxygenated conditions (> 5 mg/l) with low turbidity.

On June 3, 2021, the College partnered with Florida International University’s Water Quality Monitoring Laboratory, directed by Dr. Henry Briceño (Co-PI). Field measurements focused on: depth, DO, photosynthetically active radiation (PAR), salinity, temperature, colored

dissolved organic matter (CDOM), light attenuation coefficient (K_d), turbidity, and hydrogen sulfide (H_2S). Water samples were frozen for preservation and analyzed before 28 days in compliance with National Environmental Laboratory Accreditation Program (NELAC) Certification, and Florida International University (FIU) and Florida Department of Environmental Protection approved protocols.

On July 1, 2021, CFK conducted further field sampling in the Key West Harbor/ship channel and measured: (1) temperature ($^{\circ}C$), (2) specific conductance ($\mu S/cm$), (3) salinity (ppt), (4) DO (mg/l), (5) pH, (6) turbidity (nephelometric turbidity units or NTU), (7) ammonia nitrogen (NH_3/NH_4^+) (ppm), and (8) hydrogen sulfide (H_2S) (ppm).

On June 17, 2021, four YSI 6600 Data Sondes (Xylem Analytics, Inc.), each equipped with a conductivity, temperature, depth and turbidity probe, were transferred from the National Parks Service (Dr. Christopher Kavanaugh) to the College of the Florida Keys (CFK) to monitor water quality during the transition (Appendix A. Letters of Commitment and Support). Optical dissolved oxygen (ODO) sensors (Xylem Analytics, Inc.) were added to the sondes. Working with the FKNMS, CFK identified four locations and deployed the equipment on July 21, 2021 at: (1) Eastern Dry Rocks (EDR), (2) the Key West Ship Channel entrance (near the G3 channel marker), (3) the entrance to Key West Harbor (near channel marker G 13), and (4) Western Dry Rocks (control) (Figure 2. – blue markers). These efforts represent a minimum of equipment deployment, leaving gaps in coverage which could miss perturbations in the water quality and connectivity between EDR and the Key West Harbor/ship channel during the post-anthropause.

Therefore, the proposed Key West Harbor/Ship Channel Water Quality Monitoring project (hereafter referred to as KWWQ) intends to: (1) expand the array of *in-situ* water quality monitoring equipment at: (i) the entrance and along the Key West Shipping Channel, (ii) within Key West Harbor, (iii) area around Eastern Dry Rocks (EDR) patch reef, and (iv) Western Dry Rocks (WDR) patch reef (control); (2) collect bi-weekly water quality measurements at twelve sites in the study area, and collect water samples for subsequent lab analysis for important chemical and physical parameters; and (3) weekly deployment of an autonomous underwater vehicle (AUV) to collect water quality measurements immediately before a ship enters the channel and harbor, and in the wake of the vessel immediately after.

b. Objectives:

Objective 1. Deploy additional equipment to form a broad array of continuous water quality monitoring equipment to determine connectivity between Key West Harbor and the Key West ship channel to surrounding areas of critical concern, especially Eastern Dry Rocks Sanctuary Preservation Area (EDR-SPA).

Objective 2. For one year, perform bi-weekly field measurements and monthly collection of water samples (for lab analysis at FIU) from the waters of the Key West Harbor and along the Key West ship channel at ten predetermined sites.

Objective 3. For one year, perform bi-weekly field measurements and monthly collection of water samples (for lab analysis at FIU) from the waters at EDR and WDR for field and lab analysis to compare to Key West Harbor and Key West ship channel water samples.

Objective 4. For a period of one year, periodically (i.e. weekly if ships arrive) measure water quality immediately before and after large industrial ships enter and exit the Key West Harbor.

c. Applications, Benefits, and Importance

Applications: Previous efforts from water quality measurement and samples collected during the fall 2020, and the spring and summer 2021, indicate pristine marine waters in the Key West Harbor and ship channel, and EDR. At the time of this writing, the waters are characterized by low turbidity, high DO, and zero hydrogen sulfide. There is growing concern that the return of human activity (e.g. industrial shipping) or climactic events (e.g. hurricanes) will disturb these conditions. Therefore, the need for marine environmental baseline data will help marine resource managers to make decisions based on the best available information. This is critically important to the FKNMS and their efforts to restore EDR as part of the Mission Iconic Reefs project.

Benefits: The design of the water monitoring array will create a measurement field that will capture any disturbances to the baseline water quality conditions between the Key West Harbor and ship channel and EDR. This will allow marine resource managers to determine connectivity of the waters between KWH, KWSC, and EDR should it exist, and inform assessment measures in the event of a detectable water quality disturbance.

Importance: The National Oceanic and Atmospheric Administration (NOAA) has embarked on a bold mission investing \$100 million dollars over the next 25 years to conserve and restore seven iconic reefs within the FKNMS as part of the Mission Iconic Reefs project. Eastern Dry Rocks is the southernmost coral ecosystem identified as one of the seven “Iconic Reefs.” During normal circumstances its proximity to the Key West Harbor and ship channel would warrant increased water quality monitoring, however the importance is elevated to “critical level” given the impending increase in human activity as society transitions from the anthropause.

2. Methods and Approach: The project will expand upon current water quality monitoring efforts in the Key West Harbor/ship channel, and nearby ecologically sensitive areas. The funded project

will last one year but will be sustained indefinitely as part of the CFK marine science curriculum (Table 1) as long as the equipment remains functional.

Table 1. CFK Marine Science Courses for Participation in KWWQ				
Course	Fall	Spring	Summer	
OCB 2102C Marine Data Collection	1	1	0	
ISC 2132 Basic Research Diving	1	1	1	
ISC 3133 Advanced Research Diving	1	0	0	
OCB 2262C Assessing Coral Reef Habitats	0	0	1	
OCB 2263C Coral Reef Biology and Management	2	1	0	
OCB 2107C Monitoring Caribbean Reef Fish	0	0	1	
OCB 3035 Nearshore and Offshore Ecology & Assessment	1	0	0	
OCB 4624 Estuarine and Coastal Ecology	0	1	0	
OCB 4103L Forensic Marine Science Lab	1	0	0	
Total	7	4	3	

d. Description and Major Tasks:

Task 1: To accomplish the first objective, four YSI EXO water quality monitoring devices (Xylem Analytics, Inc.) will be procured. The devices measure conductivity ($\mu\text{S}/\text{cm}$), temperature, and depth (CTD), and equipped with optical sensors for turbidity, dissolved oxygen, and total algae (i.e. photoreactive equivalent optimized for saltwater use with *Phycoerythrin spp.*), hereafter referred to as “equipment”. The equipment collects *in-situ* water quality data at predetermined intervals and archives the data until it is manually downloaded. Depending on the sampling interval, information downloads, battery changes, and sensor maintenance (i.e. cleaning) can be conducted at intervals up to 3 months. The equipment will be mounted to a concrete anchor and secured using a 3.2mm diameter stainless steel chain (Figure 1). All four anchor mounted pieces of equipment will be added to the existing array of four YSI 6600 water quality monitoring devices. The YSI 6600 units are also capable of measuring and archiving data for CTD, turbidity,

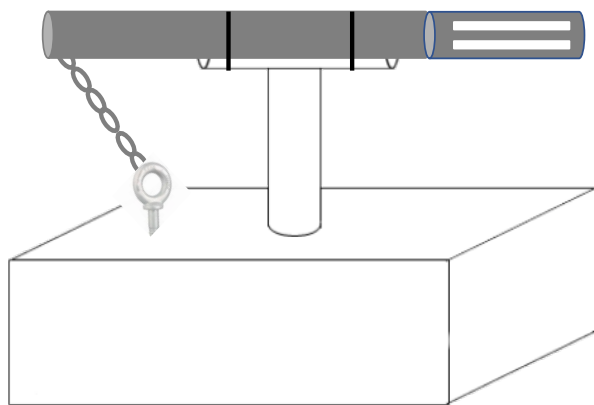


Figure 1. A schematic of the apparatus used to secure the water quality monitoring sonde for deployment in the Florida Keys National Marine Sanctuary.

and D.O. but require bi-weekly maintenance (i.e. battery changes, sensor cleaning, and data downloads). The resulting array will cover the entire study area including Western Dry Rocks (WDR) patch reef as a control site (Figure 2).

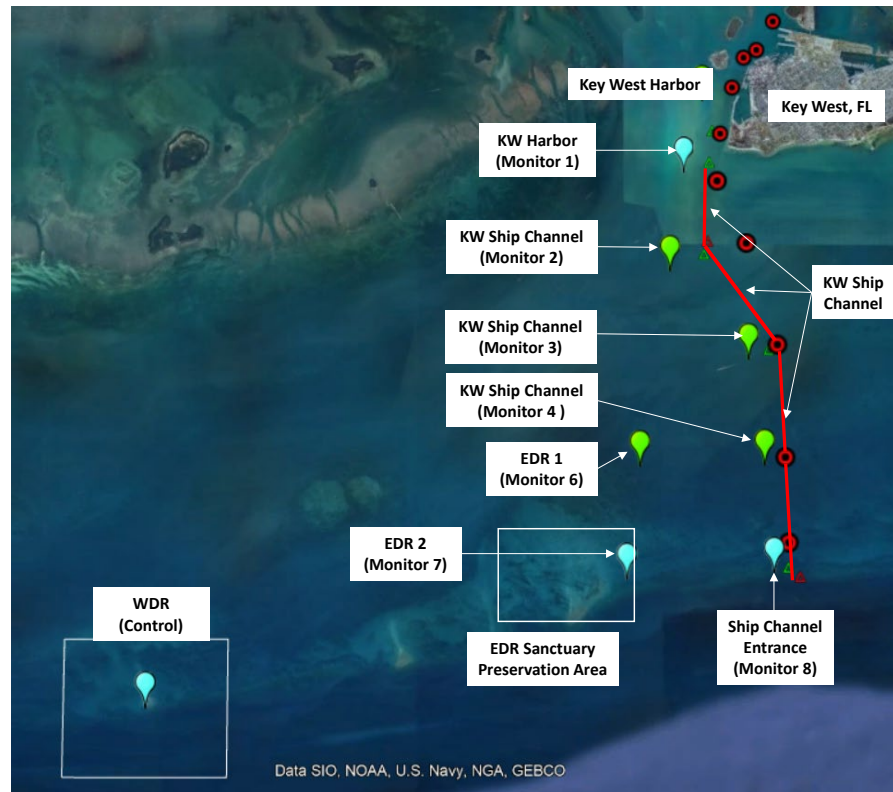


Figure 2. Chart of the Key West (KW) Ship Channel (red) with proposed locations for the expansion of a water quality monitoring array (i.e. four YSI 6600 Data Sondes - blue markers; four YSI EXO Data Sondes – green markers. Red targets (10 total) indicate locations in and near the KW Harbor/ship channel for field measurements and water samples to be analyzed later in the lab.

The College will employ a team of CFK American Academy of Underwater Science (AAUS) certified scientific divers to deploy the equipment at the pre-determined locations from the College 42-foot Corinthian catamaran diving vessel (Figure 3).



Figure 3. The College of the Florida Keys 42 ft. Corinthian catamaran (FKCC-2) used to support the Key West water quality monitoring project.

Deployments will occur during January 2022 and data collection, sensor maintenance, and battery changes will occur bi-weekly for the duration of the project (i.e. about 1 year).

Task 2: Water samples for laboratory analysis will be collected monthly for the duration of the KWWQ project

Table 2. FIU Water Sample Lab Analysis

Dissolved Inorganic Nutrients (NO ₂ ⁻ , NO ₃ ⁻ , NH ₄ ⁺ , PO ₄ ⁻³)
Total Phosphorus (TP)
Total Nitrogen - ANTEK (TN)
Total Organic Carbon (TOC) and Dissolved Organic Carbon (DOC)
Dissolved Silicate (SI)
Chlorophyll a (GF/F filtered, spectrofluorometric)

(Table 2). Biweekly trips will be conducted to: (1) continue field water quality measurements (similar to previous efforts) for depth, temperature, specific conductance, dissolved oxygen, turbidity, H₂S, salinity, pH, and ammonia nitrogen from the water/sediment interface near the bottom (approx. 20cm – 50cm), and (2) maintain the older equipment (i.e. YSI 6600) which will require bi-weekly maintenance. Titration analysis (API Saltwater Master Kit) will be used to measure NH₃/NH₄⁺ concentrations (ppm) for backup data and as an educational tool for students participating in the project. Archived turbidity data from the “equipment” will be compared to field water sample turbidity measurements to correct for data “drift” due to potential fouling over the duration of the equipment deployment, should it exist. Water samples and water quality measurements will be taken at the exact same locations as previous efforts including Western Dry Rocks Sanctuary Protected Area (WDR) (Table 3). WDR is located approximately 9.5 km west of EDR and 12.5 km from the Key West

Table 3. Water quality sample locations

Site	Latitude	Longitude
KW01	24°34'8.53" N	81°48'9.69" W
KW02	24°33'49.45" N	81°48'1.59" W
KW03	24°33'44.30" N	81°48'31.47" W
KW04	24°33'24.23" N	81°48'40.28" W
KW06	24°32'53.40" N	81°48'49.52" W
KW07	24°32'21.98" N	81°48'52.25" W
KW09	24°31'40.98" N	81°48'32.03" W
KW12	24°30'34.55" N	81°48'11.29" W
KW14	24°29'21.89" N	81°48'7.32" W
KW16	24°28'27.45" N	81°48'6.24" W
EDR	24°27'40.0" N	81°50'45.9" W
WDR	24°26'43.55" N	81°55'39.34" W

KW01-16 = Sites in Key West Harbor/ship channel

EDR = Eastern Dry Rocks, FL

WDR = Western Dry Rocks, FL

Shipping Channel entrance (KW16) and will act as a control site for comparisons of water quality measurements.

Task 3: The College has an IVER-2 autonomous underwater vehicle (AUV) that will be used for rapid water quality data collection missions immediately before and after ship traffic resumes post-anthropause. The IVER-2 is equipped with a Klein 3500 side-scan sonar, acoustic doppler current profiler (ADCP), and global positioning systems (GPS), which allows the vehicle to track the ocean floor and adjust for ocean currents and follow a pre-programmed data collection mission. The IVER-2 will be upgraded to an IVER-3 XO EcoMapper (I3XO) (Appendix D), which will incorporate YSI EXO sensors for CTD, turbidity, DO, and total algae (similar to other YSI equipment deployed *in-situ*). CFK will leverage other resources to cover approximately 50% of the cost to upgrade to the IVER-3 XO EcoMapper (est. approximately \$75K). The I3XO can be programed to autonomously collect water quality data at a predetermined depth in a back-and-forth monitoring pattern immediately before a ship enters the Key West Harbor and after the ship reaches the dock (Figure 4). After the mission is complete, the IVER AUV will return to the exact spot of deployment where it can be retrieved by the researcher and mission data can be downloaded.

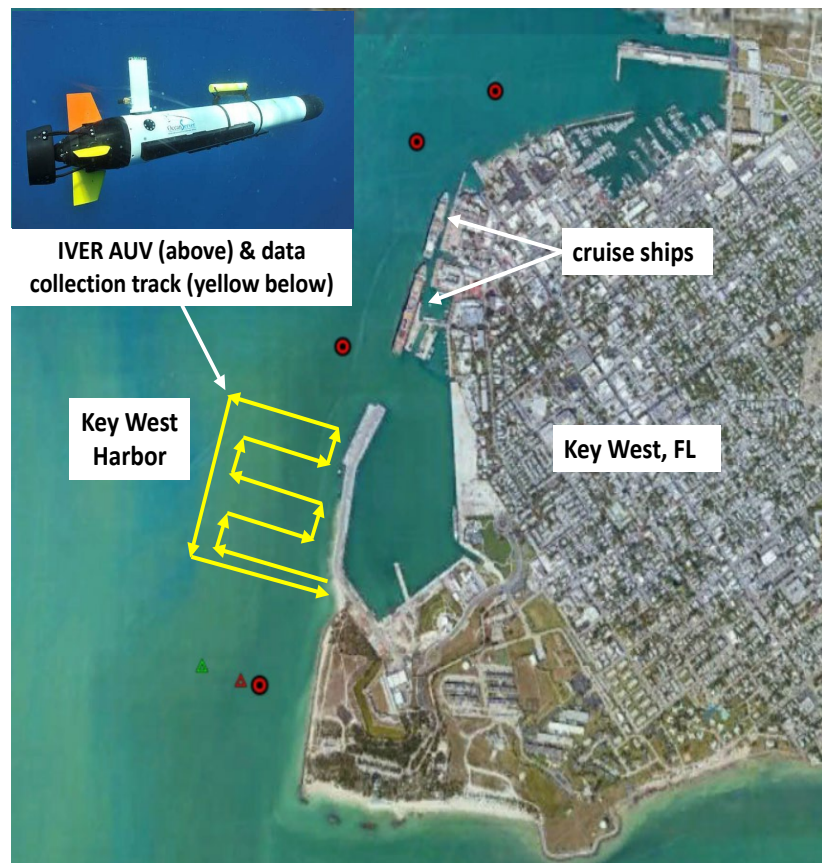


Figure 4. Aerial view of the proposed mission track for the IVER AUV during water quality monitoring in the Key West Harbor. Notice the cruise ships in port.

- e. ***Environmental Impact:*** There will be minimal impact to the environment. Each sonde anchor will have a small footprint (0.068 m²). All other water quality monitoring will depend on collection of small water samples (est. 500 ml each).
- f. ***Future Efforts:*** CFK is committed to continuing this important water quality monitoring project as long as possible even after the funding period has expired (est. January 2023). The proposed sustainability plan includes incorporating field assessments for water quality metrics at all sites identified in Table 1 into the Marine Data Collection class (OCB 2102C) [i.e. sampling for: (i) depth (m), (ii) temperature (°C), (iii) specific conductivity (µS/cm), (iv) dissolved oxygen (mg/l), (v) turbidity (NTU), (vi) H₂S (ppm), (vii) salinity (ppt), (viii) pH, and (ix) ammonia nitrogen (NH₃/NH₄⁺)]. The Marine Data Collection course is taught over a 15-week semester twice per year during the fall and spring semesters. During the course students are introduced to basic water quality analysis and several offshore trips are part of the course budget. It is also possible to introduce CFK students to the IVER AUV and its water quality monitoring capabilities. Therefore, the intention is to repeat the research protocols for water quality sampling and analysis several times during the fall and spring semesters annually in perpetuity. Moreover, CFK's Basic Research Diving (ISC 2132) and Advanced Research Diving (ISC 3133) courses would be perfectly suited to conduct periodic servicing (i.e. data download, sensor maintenance, and battery changes) on the *in-situ* water quality monitoring equipment (both YSI 6600 and XO units). Finally, as part of the College's Bachelor of Science in Marine Resource Management (MRM), several courses are well suited for deployment of the IVER AUV including: (1) OCB 3035 Nearshore and Offshore Ecology and Assessment, (2) OCB 4624 Estuarine and Coastal Ecology, and (3) OCB 4103L Forensic Marine Science Lab. In addition to MRM courses, all CFK marine science students are required to complete capstone internships and the current proposed project is ideal for

student internships. Therefore, this real-world issue provides a perfect “service learning” (i.e. education through the application of conservation science) opportunity for our marine science students, while leveraging additional College resources to sustain the KWWQ program.

3. Project Management: CFK will be the lead institution on the KWWQ project. CFK has partnered with the FKNMS, National Park Service (NPS), and FIU. The FKNMS role is to continue facilitating permitting and support project partner coordination. The NPS will continue to provide equipment (i.e. YSI 6600) and water quality monitoring expertise and guidance. FIU will be a primary partner with a lead role in water sample analysis (Table 1). Co-PI, Dr. Henry Briceño is an expert in water quality research and especially knowledgeable of the water quality in the Florida Keys (Appendix C. Bios). Dr. Briceño will be involved with most aspects of the KWWQ project, and his lab will be the lead for all laboratory water quality analysis.

Administration: The KWWQ project will be administered by CFK and follow all College policies and procedures. The Principal Investigator (PI) will be CFK Chief Science & Research Officer, Dr. Patrick H. Rice (Appendix C. Bios). The PI will be responsible for all aspects of the project. The PI will work closely with the Co-PI (Dr. Briceño) and report directly to the EPA, the Vice President (VP) of Academic Affairs, and the Executive VP Business & Chief Financial Officer (CFO) as necessary. The PI will work directly with the Director of Sponsored Programs, who will in turn report to the VP Academic Affairs on issues relating to: (1) project budget, and (2) project progress reports. The PI will be the lead and work directly with Scientific Divers, Research Assistants, and interns. The KWWQ project administrative organizational chart is shown in Figure 5.

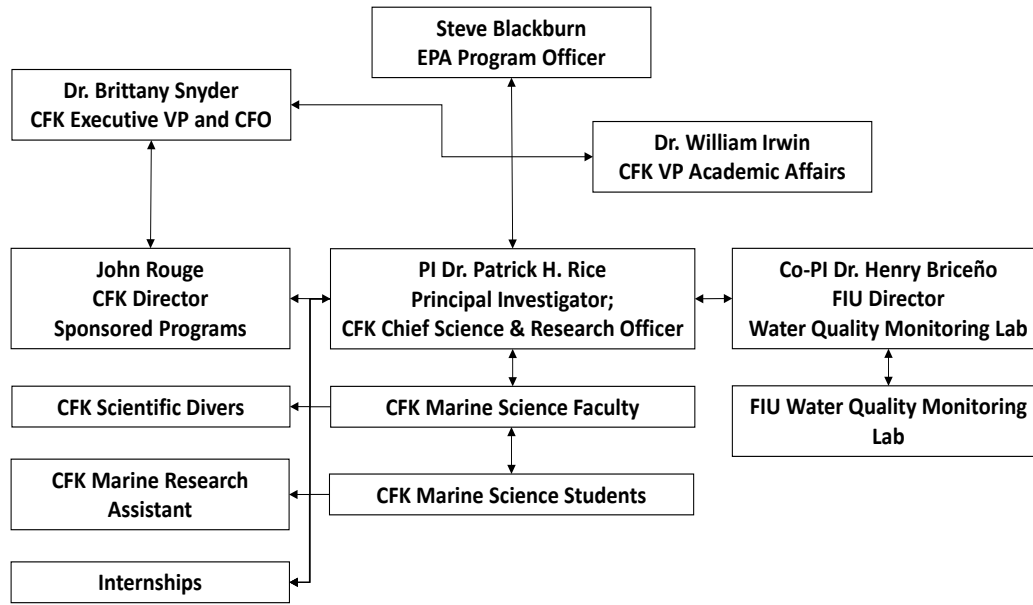


Figure 5. Proposed Key West Harbor/Ship Channel Water Quality Monitoring project administrative organizational chart.

g. ***Roles and Responsibilities:*** In addition to the PI (Rice) and Co-PI (Dr. Briceño), the KWWQ project team will consist of CFK Marine Science Faculty, CFK Scientific Divers, a CFK Marine Research Assistant, CFK Interns, and CFK marine science students. The roles and responsibilities of each are as follows:

- CFK Marine Science Faculty (Dr. Patrick Rice, Dr. Matthew Semcheski, Dr. Jason Spadaro) – will incorporate KWWQ project into marine science course curriculum during the project duration and sustain the program after the grant expires. CFK Marine Science Faculty will work with the PI (Rice), to oversee all KWWQ internships.
- CFK Scientific Divers (TBD) – will be responsible for deploying equipment on the seafloor, as well as periodic equipment maintenance (i.e. changing batteries and cleaning sensors) and data downloads.
- CFK Marine Research Assistant (TBD) – the Marine Research Assistant (MRA) will be involved with all aspects of the KWWQ project and work closely with the PI (Rice) to coordinate

projects and interns, prepare and calibrate equipment, collect data, and other various duties as assigned. A major responsibility of the MRA is to follow shipping schedules and deploy the IVER AUV for water quality data collection.

- CFK Interns (TBD) – CFK interns will work closely with CFK Faculty, the MRA, and PI (Rice). There will be one intern for the duration of the project. The intern will collect water samples and conduct water quality monitoring in the field. Interns will work with the MRA to deploy the IVER AUV to monitor water quality during ship traffic in the Key West Harbor (Figure 4). The intern will prepare technical reports for college credit, which will be used by the PI (Rice) and Co-PI (Briceño) to prepare semi-annual and final reports.
- CFK Marine Science Students (TBD) – CFK students from marine science courses (Table 1) will participate in the KWWQ project as part of their curriculum and service-learning activities.

4. Support Requirements and Conditions

i. Permits Required: Permits will be required to deploy the equipment on the seafloor within the study area of the FKNMS. The College currently has the necessary FKNMS permits (Permit # FKNMS-2021-044) for this activity based on CFK participation in the NOAA Mission Iconic Reefs project and restoration and monitoring activities at EDR.

j. Data or Facility Access: none. The College of the Florida Keys is a public institution of higher education and therefore all official College activities are public record.

5. Project Schedule

k. Milestones and Deliverable Schedule: Project milestones and deliverables are outlined in Table 4 and indicate the responsible party for each milestone or deliverable. Also indicated is the previous effort upon which the proposed project builds. Each milestone is paired with an anticipated month for delivery for the duration of the one year project and project close-out.

Table 4. Milestones and Deliverables Schedule

Deliverables	Responsible Party	Pre-Award effort	Month												Close-out
			1	2	3	4	5	6	7	8	9	10	11	12	
Award letter received	PI														
Hire staff	PI														
Upgrade IVER AUV	PI, MRA														
Purchase equipment and materi	PI, MRA														
Schedule research trips	PI, Co-PI, A														
Incorporate field samples into	PI, F														
Deploy YSI equipment array	PI, MRA, S														
Quarterly stakeholder meetings	E														
Conduct field studies	F, PI														
Water sample analysis	Co-PI														
Semi-annual report	PI, Co-PI														
Analyze data	PI, Co-PI, MRA														
Internship technical report	PI, I														
Final Report	PI, Co-PI														

PI = Principal Investigator; Co-PI= Co-principal investigator; MRA = Marine Research Assistant, S = Scientific Divers, F = marine science faculty; I = Interns; E= everyone

6. Environmental Results:

1. *Outputs and Outcomes:*

- **Outputs** - The KWWQ project will provide important water quality data on chemical and physical properties of the waters within the FKNMS and specifically proximal to the EDR sanctuary preservation area.
- **Outcomes** – The KWWQ project will provide useful information for marine resource managers, as well as municipal, regional, state, and federal agencies and legislators.

m. Tracking Outputs and Outcomes: Progress on outputs and outcomes will be tracked during quarterly stakeholder and partnership meetings. Meetings will be virtual to allow for broad participation and feedback.

7. Programmatic Capability and Past Performance: (i) Current funding (See Table 5 below).

All reporting requirements have been met. (ii) The College of the Florida Keys has no history of delinquency on any mandatory reporting requirements.

Table 5. Current Federal, Regional, and Non-Profit funding at the College of the Florida Keys

Grant Agency	Award Amount	Grant Award no.	Subcontract	Project Title
The National Science Foundation (NSF) - Advanced Technological Education	\$ 894,641.00	1601440	NA	Developing a 21st Century Training Program in the Florida Keys for Renewable Alternative Energy Technology: Wind, Solar and Tidal Power
NSF - Dept. of Undergraduate Education	\$ 1,917,670.00	1928591	NA	Developing Reliable Educational Avenues to STEM Careers
Gulf States Marine Fisheries Commission	\$ 124,000.00	NA15NMF47203399	ACQ-210-039-2020-CFK	From guts to glory: Evaluating visceral discards from commercial fisheries as a viable alternative for male broodstock during grouper aquaculture
Coral Restoration Foundaion	\$ 19,668.00	NA	NA	Coral Restoration Foundation MOU
National Oceanic & Atmospheric Administration	\$ 62,664.00	NA20NMF4630328	21-02-D-307	Restoring and Protecting U.S Marine Habitats
Total	\$ 3,018,643.00			

8. Budget Summary (Total**request = \$299,968.18):** A

detailed budget summary is given

in Table 6 with quantities for each

item, unit cost and total price.

Quotes for equipment are given in

Appendix D. Sources/values for

materials and supplies are given in

Appendix E. Six EXO probes

allow one back-up probe for each

sensor type. The College indirect

rate is 48% (Appendix B) and only

applies to modified total direct

costs (MTDC) for personnel,

fringe, materials and supplies, and

other costs excluding “Participant

Support” for the proposal.

Table 6. Key West Ship Channel Water Quality Monitoring Budget

a. Personnel	Qty	Unit	Unit Price	Total
Co-PI (Rice)	2	month	\$ 8,000.00	\$ 16,000.00
Scientific Divers (3)	576	hr	\$ 17.50	\$ 10,080.00
Marine Research Assistant	520	hr	\$ 17.50	\$ 9,100.00
b. Fringe	-	%	-	
Co-PI (Rice)				\$ 3,853.86
Scientific Divers (3)				\$ 2,016.00
Marine Research Assistant				\$ 1,820.00
c. Travel	2	day	\$ 386.00	\$ 772.00
d. Equipment	-	-	-	
YSI EXO Sonde (100 m depth; 4 ports)	4	sondes	\$ 4,249.15	\$ 16,996.60
IVER 2 Upgrade	1	unit	\$ 85,819.00	\$ 85,819.00
e. Materials and Supplies				
YSI EXO Optical DO Sensor	6	probe	\$ 1,699.15	\$ 10,194.90
YSI EXO Turbidity Sensor	6	probe	\$ 1,568.25	\$ 9,409.50
YSI EXO Total Algae Sensor	6	probe	\$ 2,975.00	\$ 17,850.00
YSI EXO replacement sensor kit	2	kits	\$ 69.00	\$ 138.00
YSI EXO sensor cleaning brush	5	brush	\$ 12.00	\$ 60.00
Hydrogen Sulphide (H2S) test strips	6	packs	\$ 28.85	\$ 173.10
Turbidity calibration std. (10 NTU)	24	liter	\$ 130.00	\$ 3,120.00
YSI 6600 CTD probes	1	probe	\$ 782.00	\$ 782.00
YSI CTD Calibration solution (58K µS/cm)	2	5 gal	\$ 130.00	\$ 260.00
YSI 6600 turbidity probes	1	probe	\$ 1,848.75	\$ 1,848.75
YSI 6600 dissolved oxygen (DO) probes	1	unit	\$ 2,125.00	\$ 2,125.00
Batteries (Size D) for YSI EXO	8	8-pack	\$ 13.56	\$ 108.48
Batteries (Size C) for YSI 6600	50	8-pack	\$ 16.00	\$ 800.00
Concrete	4	47 lb	\$ 12.99	\$ 51.96
PVC, primer, and glue	-	-	-	\$ 50.00
Stainless steel chain	10	ft.	\$ 2.19	\$ 21.90
f. Contractual	-	-	-	-
FIU Co-PI (Briceño)	1.5	month	\$ 9,343.94	\$ 14,015.91
FIU Co-PI (Briceño)				\$ 3,375.96
g. Other				
Vessel	24	day	\$ 950.00	\$ 22,800.00
Water sample analysis	168	sample	\$ 178.00	\$ 29,904.00
Shipping	-	-	-	\$ 500.00
Misc.	-	-	-	\$ 250.00
Participant support (Interns)	225	hr	\$ 15.00	\$ 3,375.00
Subtotal				\$ 267,671.92
MTDC				\$ 161,481.32
CFK Indirect (48% = 28% match + 20% request)				\$ 32,296.26
Total				\$ 299,968.18

9. Subawards: FIU will be a subaward to cover Co-PI (Briceño) effort and fringe (Table 5).

10. Voluntary cost share/match and other leveraged funds: The cost for upgrades to the IVER AUV is \$162,004. CFK intends to leverage resources (\$76,185) to upgrade the AUV to an I3XO Ecomapper and therefore requests the balance (\$85,819). Also, CFK's indirect rate is 48% however, due to the unique and important opportunity of the proposed work, CFK is willing to donate 28% of the indirect cost rate (\$45,214.77) and only charge 20% IDC (\$32,296.26).

11. Partnership with other entities: The College has partnered with FIU, FKNMS, and NPS, proposed KWWQ project (see Project Narrative for more details).

12. Information Transfer: The PI (Rice) and Co-PI (Briceño) will provide a technical report on the project. CFK will host a public VIP (Visions, Insights, and Perspectives) seminar during Spring of 2023. PI (Rice) and/or Co-PI (Briceño) present the KWWQ findings. If warranted, PI (Rice) and Co-PI (Briceño) will draft a manuscript for a peer reviewed publication (journal TBD).

13. Literature Cited:

Asaoka, S., T. Yamamoto, S. Kondo, S. Hayakawa. 2009. Removal of hydrogen sulfide using crushed oyster shell pore water to remediate organically enriched coastal marine sediments. *Bioresource Technology*. Vol. 100 (18): 4127-4132.

Briceño, H. 2021. Preliminary Assessment of Surface Water Clarity Changes in Key West during the COVID-19 Anthro pause. Florida International University, Institute of Environment, Water Quality Monitoring Lab.

Murray, T.J, & Associates, 2005. The Impacts of the Cruise Ship Industry on the Quality of Life in Key West. RFQ No: 04-001. City of Key West Naval Properties Local Redevelopment Authority.

Appendix A. Letters of Commitment & Support



United States Department of the Interior NATIONAL PARK SERVICE

Everglades and Dry Tortugas National Parks
South Florida Natural Resources Division
950 North Krome Avenue, 3rd Floor
Homestead, Florida 33030



In Reply Refer to:

July 22, 2021

Steve Blackburn
Program Officer (Region IV)
Environmental Protection Agency (EPA)
Atlanta, Georgia, United States

Dear Mr. Blackburn,

I am writing this letter to support the application for the Environmental Protection Agency (EPA) Federal Funding Opportunity (EPA-R4-SFL-2021-01) entitled "Monitoring Water Quality in the Key West Ship Channel and surrounding ecologically and culturally significant coral reefs pre- and post-COVID-19 Anthropause" submitted jointly by The College of the Florida Keys (CFK) and Florida International University (FIU).

The National Park Service, through involvement as a partner agency in the Florida Keys National Marine Sanctuary advisory council, agreed to provide four YSI 6600 data sondes with sensors for conductivity, temperature, depth, and turbidity for temporary use in the sanctuary. The instruments were transferred to CFK (June 13, 2021) for the purpose of deployment to monitor and archive water quality data for six months during the period of cessation of cruise ship traffic during the COVID-19 pandemic. The NPS recognizes that the absence of human activity created a unique opportunity to observe the marine environment around Key West. The NPS also recognizes the potential for environmental disturbances once human activity resumes. Therefore, the NPS agrees (after a status review in December 2021) to a possible extension of use of six months to June 12, 2022 dependent upon the Park's need for the devices in the future.

We anticipate that the partnership of the College of the Florida Keys with Florida International University on this time-sensitive project has a high probability for success to describe the turbidity patterns in the Key West harbor area, with CFK providing local leadership, resources, and technicians, and FIU providing expertise and guidance on water quality monitoring and water sample analysis. The National Park Service has committed the tangible resources, supplies and advice to support this activity and contribute to its success.

Sincerely,

CHRISTOPHER KAVANAGH

Christopher Kavanagh, Marine Ecologist
Everglades National Park
Florida Bay Interagency Science Center
98630 Overseas Highway
Key Largo, Florida 33037

Digitally signed by CHRISTOPHER KAVANAGH
Date: 2021.07.22 16:03:05 -04'00'



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
Florida Keys National Marine Sanctuary

33 East Quay Road Key West, FL 33040
Phone: (305) 809-4700 Fax: (305) 293-5011

July 6, 2021

Steve Blackburn
Program Officer (Region IV)
Environmental Protection Agency
Atlanta, Georgia, United States

Dear Mr. Blackburn,

I am writing this letter in support of the application for the Environmental Protection Agency Federal Funding Opportunity (EPA-R4-SFL-2021-01) entitled "Monitoring Water Quality in the Key West Ship Channel and Surrounding Ecologically and Culturally Significant Coral Reefs Pre- and Post-COVID-19 Anthropause" submitted jointly by The College of the Florida Keys (CFK) and Florida International University (FIU).

The Florida Keys National Marine Sanctuary (FKNMS) has a mandate to protect the 3,800 square miles of coral reefs, seagrass beds, shipwrecks and other nationally significant natural and cultural resources within the marine waters surrounding the Florida Keys. Over the next decade, FKNMS is specifically focused on restoring seven "Iconic Reefs" including the ecologically sensitive and culturally important coral reef habitats at Eastern Dry Rocks (EDR) Sanctuary Preservation Area. FKNMS recognizes that protecting and restoring water quality is important for the overall success of coral restoration efforts and supports additional data collection to better understand the status of and potential impacts to water quality in the vicinity of the Iconic Reef sites. The Anthropause created a unique opportunity to observe the marine environment during a period of reduced human disturbance as a result of closures associated with the COVID-19 pandemic. Given the proximity of EDR to the Key West Ship Channel and the Key West Harbor, the FKNMS supports the efforts of CFK and FIU to monitor and assess the water quality near Key West, FL and its connectivity with the waters of EDR.

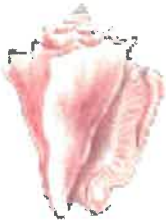
The partnership between the CFK and FIU is uniquely suited to accomplishing this important project, with CFK providing local leadership, resources, and technicians, and FIU providing years of expertise and guidance on water quality monitoring and water sample analysis in the Florida Keys. FKNMS strongly encourages the favorable consideration of this grant application. Please let me know if you have any questions.

Sincerely,

Sarah Fangman
Superintendent
Florida Keys National Marine Sanctuary



Teri Johnston
Mayor



1300 White Street
(305) 809-3840
tjohnston@cityofkeywest-fl.gov

THE CITY OF KEY WEST

P.O. BOX 1409
KEY WEST, FL 33041-1409

Steve Blackburn
Program Officer (Region IV)
Environmental Protection Agency (EPA)
Atlanta, Georgia, United States

July 07, 2021

Dear Mr. Blackburn,

My name is Teri Johnston, Mayor of the City of Key West, FL. I am writing this letter in support of the application for the Environmental Protection Agency (EPA) Federal Funding Opportunity (EPA-R4-SFL-2021-01) entitled "Monitoring Water Quality in the Key West Ship Channel and surrounding ecologically and culturally significant coral reefs pre- and post-COVID-19 Anthropause" submitted jointly by The College of the Florida Keys (CFK) and Florida International University (FIU).

The City of Key West is immersed within the heart of the Florida Keys National Marine Sanctuary and has a long history of environmental stewardship of the surrounding marine waters. We recognizes that the Anthropause (i.e. lack of human activity due to the COVID-19 pandemic) created a unique opportunity to observe the marine environment around Key West without substantial disturbance from humans. The City also recognizes the potential for environmental disturbances once human activity resumes. Given the proximity of the Key West Ship Channel and the Key West Harbor, to many environmentally sensitive areas, the City of Key West supports the efforts of CFK and FIU to monitor and assess the water quality near Key West, FL and it's connectivity with the surrounding waters.

We are encouraged to see our local College partnering with an esteemed research institution like FIU on this important project which provides the optimal probability for success, with CFK providing local leadership, resources, and technicians, and FIU providing years of expertise and guidance on water quality monitoring and water sample analysis. Therefore, the City of Key West strongly encourages the favorable consideration of this grant application.

Please feel free to contact me should you have any questions or need any additional information.

Sincerely,

Teri Johnston
Mayor, City of Key West
1300 White Street
Key West, FL 33040
Phone: (305) 809-3840
Email: tjohnston@cityofkeywest-fl.gov



SOUTH FLORIDA WATER MANAGEMENT DISTRICT

3301 Gun Club Road, West Palm Beach, Florida 33406 • (561) 686-8800 • FL WATS 1-800-432-2045 • TDD (561) 697-2574
Mailing Address: P.O. Box 24680, West Palm Beach, FL 33416-4680 • www.sfwmd.gov

July 20, 2021
Steven Blackburn
Program Officer (Region IV)
Environmental Protection Agency (EPA)
Atlanta, Georgia, United States

Dear Mr. Blackburn,

As the Lead Scientist for the Everglades/Florida Bay Ecosystem Laboratory at the South Florida Water Management District (SFWMD), I am writing in support of the proposal "Monitoring water quality in the Key West Ship Channel and surrounding ecologically and culturally significant coral reefs pre- and post-COVID-19 Anthropause." The application is submitted jointly by The College of the Florida Keys and Florida International University to EPA Federal Funding Opportunity (EPA-R4-SFL-2021-01).

My laboratory at SFWMD has been engaged in research in Florida Bay and the Florida Keys for over 20 years, aimed at understanding the connectivity of the marine ecosystems of South Florida and the Florida Keys National Marine Sanctuary. The reduction in human activity during the anthropause presents a unique opportunity for this project to assess the status of the marine environment during a period of reduced human impact in ecologically important areas in and around Key West. The subsequent increase in the intensity of human activity will also permit the observation of potential environmental impacts on critical ecosystem components, such as coral reefs and seagrass beds. This presents a timely and urgent opportunity to assess water quality and habitat effects in Key West and surrounding waters, and their relationship to human activity.

I am encouraged by the synergy of The College of the Florida Keys' local expertise, leadership and resources, and Florida International University's experience in large-scale projects on ecosystem science and water quality analysis. This partnership presents an optimal probability for success. I strongly support this project and I look forward to benefiting from its products and findings in pursuit of SFWMD's missions of water management and environmental stewardship. Please let me know if you have any questions.

Sincerely,

A handwritten signature in black ink, reading "Christopher J. Madden". The signature is fluid and cursive.

Christopher J. Madden, Ph.D.
Lead Scientist
Everglades/Florida Bay Ecosystem Laboratory
South Florida Water Management District
8894 Belvedere Rd.
West Palm Beach, FL 33411
ph: 561-686-8800 ext 4647
Email: cmadden@sfwmd.gov



FLORIDA DEPARTMENT OF Environmental Protection

South District Branch Office
2796 Overseas Highway, Suite 221
Marathon, FL 33050
SouthDistrict@FloridaDEP.gov

Ron DeSantis
Governor

Jeanette Nuñez
Lt. Governor

Shawn Hamilton
Interim Secretary

July 12, 2021

Steve Blackburn
Program Officer (Region IV)
Environmental Protection Agency (EPA)
Atlanta, Georgia, United States
Blackburn.Steven@epa.gov

Dear Mr. Blackburn,

I am writing this letter to support the application for the Environmental Protection Agency (EPA) Federal Funding Opportunity (EPA-R4-SFL-2021-01) entitled "Monitoring Water Quality in the Key West Ship Channel and surrounding ecologically and culturally significant coral reefs pre- and post-COVID-19 Anthropause" submitted jointly by The College of the Florida Keys (CFK) and Florida International University (FIU).

The Water Quality Protection Program (WQPP), recognizes the need to collect water quality data during the Anthropause (i.e. Reduced human activity due to the COVID-19 pandemic). The Pandemic has created a unique opportunity to monitor the marine environment around Key West during this period of reduced human activity.

I am encouraged by the local College partnering with a qualified research institution like FIU on this important project. Therefore, I strongly support this project and recommend the favorable consideration of this grant application. Please let me know if you have any questions.

Sincerely,

A handwritten signature in black ink, appearing to read "Gus Rios".

Gustavo Rios, Program Administrator
Florida Department of Environmental Protection
South District Marathon Office
(305) 289-7081
Gus.Rios@FloridaDEP.gov

Florida Keys Commercial Fishermen's Association

P.O. Box 501404, Marathon, FL 33050

Phone & Fax: 305-743-0294 Cell: 305-619-0039
E-mail: FKCFA1@hotmail.com Website: FKCFA.Org

July 5, 2021

Mr. Steven Blackburn
Program Officer (Region IV)
Environmental Protection Agency (EPA)
Atlanta, Georgia, United States

Dear Mr. Blackburn,

My name is Bill Kelly and I am the Executive Director of the Florida Keys Commercial Fishermen's Association (FKCFA). I am writing this letter to support the application for the Environmental Protection Agency (EPA) Federal Funding Opportunity (EPA-R4-SFL-2021-01) entitled "Monitoring Water Quality in the Key West Ship Channel and surrounding ecologically and culturally significant coral reefs pre- and post-COVID-19 Anthropause" submitted jointly by The College of the Florida Keys (CFK) and Florida International University (FIU).

The FKCFA recognizes that the quality of the marine environment directly impacts our productivity. We understand that the absence of human activity (i.e. Anthropause) has created a unique opportunity to observe the marine environment around Key West, but also understand the potential for environmental disturbances once human activity resumes. Therefore, there is a timely need to monitor the water quality around Key West, FL.

We are encouraged by the local College partnering with an esteemed research institution like FIU on this important project which provides the optimal probability for success, with CFK providing local leadership, resources, and technicians, and FIU providing years of expertise and guidance on water quality monitoring and water sample analysis. Therefore, the FKCFA strongly supports this project and soundly encourages the favorable consideration of this grant application. Please let me know if you have any questions.

Sincerely,

/s/ Bill Kelly

Capt. Bill Kelly
Executive Director

July 19, 2021

Steve Blackburn
Program Officer
Environmental Protection Agency (EPA)
Atlanta, Georgia, United States

Dear Mr. Blackburn:

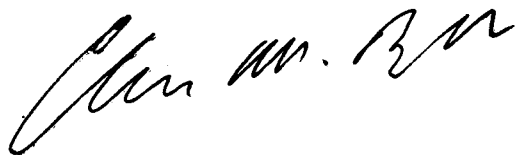
The Nature Conservancy (TNC) strongly supports The College of the Florida Keys' (CFK) and Florida International University's (FIU) application for the Environmental Protection Agency (EPA) Federal Funding Opportunity (EPA-R4-SFL-2021-01) entitled "Monitoring Water Quality in the Key West Ship Channel and surrounding ecologically and culturally significant coral reefs pre- and post-COVID-19 Anthropause."

TNC has a vested interest in the environmental health of the waters in and around Key West. We worked to establish the Florida Keys National Marine Sanctuary and our staff, myself included, have served on the Sanctuary Advisory Council and Water Quality Protection Program Steering Committee since the 1990's. We base our work on science and strive for conservation of the lands and waters on which all life depends. Turbidity and potentially other forms of water quality degradation associated with deep draft vessels off Key West has been a concern of ours, and of numerous other stakeholders, for many years. The "anthropause" has provided a unique opportunity to observe the marine environment's response to abatement of this threat. TNC supports the efforts of CFK and FIU to monitor and assess the water quality near Key West, FL, and its connectivity with the waters of the ecologically sensitive coral reef habitats at Eastern Dry Rocks Sanctuary Preservation Area and beyond.

We applaud the partnership between CFK and FIU on this important project which provides the optimal probability for success, with CFK providing local leadership, resources, and technicians, and FIU providing years of expertise and guidance on water quality monitoring and water sample analysis. Therefore, TNC strongly encourages the favorable consideration of this grant application.

Thank you for your consideration, and please let me know if you have any questions.

Sincerely,



Chris Bergh
South Florida Program Manager
Phone: 305.587.4037
Email: cbergh@tnc.org

Appendix B. CFK Indirect Rate Agreement

COLLEGES AND UNIVERSITIES RATE AGREEMENT

EIN: 59-1209205

DATE: 01/11/2021

ORGANIZATION:

The College of the Florida Keys
5901 College Road
Key West, FL 33040

FILING REF.: The preceding
agreement was dated
01/08/2018

The rates approved in this agreement are for use on grants, contracts and other agreements with the Federal Government, subject to the conditions in Section III.

SECTION I: Facilities And Administrative Cost Rates

RATE TYPES: FIXED FINAL PROV. (PROVISIONAL) PRED. (PREDETERMINED)

EFFECTIVE PERIOD

<u>TYPE</u>	<u>FROM</u>	<u>TO</u>	<u>RATE(%) LOCATION</u>	<u>APPLICABLE TO</u>
PRED.	07/01/2017	06/30/2021	48.00 On-Campus	All Programs
PRED.	07/01/2021	06/30/2025	48.00 On Campus	All Programs
PROV.	07/01/2025	Until Amended		Use same rates and conditions as those cited for fiscal year ending June 30, 2025.

BY THE INSTITUTION:

The College of the Florida Keys

(INSTITUTION)

(SIGNATURE)

Dr. Jonathan Gueverra

(NAME)

President/CEO

(TITLE)

1/27/21

(DATE)

ON BEHALF OF THE FEDERAL GOVERNMENT:

DEPARTMENT OF HEALTH AND HUMAN SERVICES

Darryl W. Mayes

-S

(SIGNATURE)

for

Arif Karim

(NAME)

Director, Cost Allocation Services

(TITLE)

1/11/2021

(DATE) 3036

HHS REPRESENTATIVE: Ernest Kinneer

Telephone: (214) 767-3261

*BASE

Modified total direct costs, consisting of all direct salaries and wages, applicable fringe benefits, materials and supplies, services, travel and up to the first \$25,000 of each subaward (regardless of the period of performance of the subawards under the award). Modified total direct costs shall exclude equipment, capital expenditures, charges for patient care, rental costs, tuition remission, scholarships and fellowships, participant support costs and the portion of each subaward in excess of \$25,000. Other items may only be excluded when necessary to avoid a serious inequity in the distribution of indirect costs, and with the approval of the cognizant agency for indirect costs.

Appendix C. PI and Co-PI Bios



THE
COLLEGE
OF THE
FLORIDA KEYS

PATRICK HAYS RICE, Ph.D.
Chief Science & Research Officer

Education

Ph.D. (with honors) Division of Marine Biology & Fisheries (2008)
University of Miami – Rosenstiel School of Marine & Atmospheric Science, Miami, Florida

M.S. Wildlife and Fisheries Sciences (2000)
Texas A&M University, College Station, Texas

B.S. Biology, emphasis on Aquatic Biology (1992)
University of Texas, Austin, Texas

Professional

Chief Science & Research Officer (2017 – Present)
College of the Florida Keys, Key West, FL

Dean of Marine Science & Technology (2010 – 2017)
Florida Keys Community College, Key West, FL

Featured Publications

Rice, P.H., C.P., Prince, E.D., Snodgrass, D., and Serafy, J.E. 2012. Performance of non-offset and 10° offset circle hooks in the U.S. pelagic longline fishery. *Bull. Mar. Sci.* 88(3):571–587. 2012
<http://dx.doi.org/10.5343/bms.2011.1095>

Rice, P.H. 2008. Factors affecting the catch of target and bycatch species during commercial pelagic longline fishing. University of Miami – Rosenstiel School of Marine and Atmospheric Science, <http://etd.library.miami.edu/theses/available/etd-04182008-122424/>, pp.178.

Rice, P., 2008. A shocking discovery: How electropositive metals work and their effects on elasmobranchs. In: Swimmer, Y., Wang, J.H., McNaughton, L.S. (Eds.), *Shark Deterrent and Incidental Capture Workshop*, NOAA Technical Memorandum NMFS-PIFSC-16, pp. 21-10 25.

Rice, P.H., Goodyear, C.P., Prince, E.D., Snodgrass, D., and Serafy, J.E. 2007. Use of catenary geometry to estimate hook depth during near surface pelagic longline fishing: theory versus practice. *North American Journal of Fisheries Management* 27: 1148-1161

Rice, P., Ray, S.M., Painter, S.D., and Nagle, G.T. 2002. An intrinsic membrane protein in sperm stimulates spawning behavior in the oyster *Crassostrea virginica*: Implications for aquaculture. *Journal of Shellfish Research* 21(2): 715-718

Rice, P.H. (2000). The effects of selected environmental variables on filtration rate of *Mytilopsis leucophaeata* and evaluation of its potential role in the purification of mariculture effluent. Master's Thesis. Texas A&M University Press. <http://repository.tamu.edu/handle/1969.1/ETD-TAMU-2000-THESIS-R52?show=full>.

SCUBA

American Academy of Underwater Sciences (AAUS) – Scientific Diver, NOAA NITROX, Cavern Diver, NAUI Master Diver, NAUI advanced open water, PADI open water.

Henry O. Briceño, PhD

A. PROFESSIONAL PREPARATION

<u>College/University</u>	<u>Major</u>	<u>Degree &Year</u>
Colorado School of Mines, Golden, CO	Geological Engineer	BS, 1973
Colorado School of Mines, Golden, CO	Geology/Geochemistry	MS, 1975
Colorado School of Mines, Golden, CO	Geology/Remote Sensing	PhD, 1982

B. APPOINTMENTS

2004-Present	Research Professor. Florida International University/SERC, Miami, FL
1976-2005	Associate Professor. Central University of Venezuela, Caracas
1998-1999	Vice-President. Petroriental NV., Caracas, Curacao, Bogotá
1995-1997	Vice-President. Canyon Resources Venezuela, Caracas
1990-1993	Corporate Mining Planning & Control Manager, CVG, Pto Ordaz, Venezuela.

C. RELEVANT PRODUCTS

- Briceño, H.O., J.N. Boyer. 2021. 2020 Annual Report of the Water Quality Monitoring Project for the Water Quality Protection Program of the Florida Keys National Marine Sanctuary. Submitted to EPA. FIU 101 p
- Seidensticker. 2019. Seasonal and Interannual Variability in Net Ecosystem Production of a Subtropical Coastal Lagoon Inferred from Monthly Oxygen Surveys. <https://doi.org/10.1007/s12237-018-0482-8>
- Danielson, Tess, et al. 2017. Assessment of Everglades Mangrove Forest Resilience: Implications for Aboveground Net Primary Productivity. *Forest Ecology and Management*. [Volume 404](https://doi.org/10.1016/j.foreco.2017.08.009), 15 November 2017, Pages 115-125. <https://doi.org/10.1016/j.foreco.2017.08.009>
- Regier, Peter, Henry Briceño, Rudolf Jaffe. 2016. Long-term environmental drivers of DOC fluxes: <https://www.sciencedirect.com/science/article/pii/S027277141630395X?via%3Dihub>
- Briceño, H.O., J.N. Boyer, J. Castro and P. Harlem. 2013. Biogeochemical Classification of South Florida's Estuarine and Coastal Waters. <https://doi.org/10.1016/j.marpolbul.2013.07.034>
- Briceño, H.O., and J.N. Boyer. Climatic Controls on Phytoplankton Biomass https://www.jstor.org/stable/40663711?seq=1#metadata_info_tab_contents
- Briceño, Henry O. et al. 2011. Ecological Impacts on Biscayne Bay and Biscayne National Park from South Miami-Dade County Development, <http://serc.fiu.edu/wqmnetwork/BNP/Final%20Report%20BNP.pdf>

D. SYNERGISTIC ACTIVITIES

- PI for Water Quality Monitoring of the Florida Keys National Marine Sanctuary
- Academic Vice-Chair for Southeast Florida Coral Reef Initiative, and TAC member for the Florida Keys National Marine Sanctuary.
- Water Quality Coordinator for UNESCO Water Security Chair

Appendix D. YSI Quotes



Quote Number: B176125
Date Created: 2020 Feb 12
Quote Expiration Date: 2021 Dec 31

Quote Prepared For:
Patrick Rice
Florida Keys Community College
5901 College Rd
Key West, FL 33040
(305) 809-3228
patrick.rice@fkcc.edu

Project Description:
Including photogrammetry. Budgetary for funding proposal
20% off certain items for upgrade from IVER 2

Prepared by: Jon Fajans
Cell Phone:
Office Phone:
Email: jon.fajans@xylem.com



Quote #: B176125
Expires: 2021 Dec 31

Proposal Summary

Upgrade of IVER2 to IVER3 (I3EXO)

Re-use existing tail section, Klein Side Scan, Compass and upgrade existing hand held unit to new ruggedized hand held compatible with IVER3 platform. Include VR tail section maintenance program.

#	Part Number	Description	List Price	Discount	Net Price	Qty	Ext. Price
1	202580	I3XO EcoMapper AUV Base Model Includes: - Built in Wifi - Phased Array, downward looking DVL; Bottom Tracking and Profiling - Forward Object Avoidance Sensor - EXO1 OEM Kit with C/T probe - Transport Cases - Acoustic Pinger - Vehicle Stand - Automated Vacuum Test Assembly	\$153,090.00	20.00%	\$122,472.00	1	\$122,472.00
2	202579	I3XO Field Spares Kit Includes: - Pelican transport case - Complete o-ring, hardware, grease, and anodes spares kit - Tail barrier seal maintenance kit - Leak detection sensors - Spare ballast weight - Spare control fins - I3XO specific tools - Additional storage compartments for; Getac Console, Handheld Remote, and Vacuum Test Assembly	\$3,340.00	20.00%	\$2,672.00	1	\$2,672.00

Subtotal \$125,144.00

The following items have been grouped together.

#	Part Number	Description	List Price	Discount	Net Price	Qty	Ext. Price
1	351216	i3XO AUV Mounted Acoustic Modem Includes: -Benthos ATM-900-BC1 Acoustic Modem with External Transducer -Fully Integrated in Vectormap mission planning software provides real time status and position in VectorMap with compatible OceanServer Deck box	\$15,250.00	0.00%	\$15,250.00	1	\$15,250.00*
2	351217	i3XO Acoustic Modem Deck Box Includes: -Li Ion Battery Powered Deck box transducer kit for communication with EcoMapper -10 Meter Cable to lower deck box transducer in water Transducer ATM-916-BC1	\$16,750.00	0.00%	\$16,750.00	1	\$16,750.00*

* The optional items are not included in Grand Total calculations below.

Optional Subtotal	\$32,000.00
-------------------	-------------

#	Part Number	Description	List Price	Discount	Net Price	Qty	Ext. Price
2	202576	i3XO Iridium Airtime Service - 1500 messages or 1 year; whichever comes first - 1 year access to www.Track-Iver.net - Used to get vehicle status, location, run preloaded missions, and use Drive-to-Me feature	\$1,270.00	0.00%	\$1,270.00	1	\$1,270.00*

* The optional items are not included in Grand Total calculations below.

Optional Subtotal	\$4,860.00
-------------------	------------

IVER 2 → I3XO Total = \$162,004

YSI EXO1 Sonde with sensors (ODO, Turbidity, Total Algae)

#	Part Number	Description	List Price	Discount	Net Price	Qty	Ext. Price
1	599501-02	EXO1 Sonde, 100 meter Depth, 4 Sensor Ports - Depth range: 0-100 meters - Contains: Sonde, 2 'D' Batteries, Calibration Cup, Tool Kit, 2 Port Plugs, USB drive loaded with Manual and KOR Software	\$4,999.00	15.00%	\$4,249.15	3	\$12,747.45
2	599100-01	EXO Optical DO Sensor, Ti - Compatible with any EXO sonde - User replaceable sensor cap (installed) - Incorporates wet-mate connector and welded titanium housing	\$1,999.00	15.00%	\$1,699.15	3	\$5,097.45
3	599101-01	EXO Turbidity Sensor, Ti - Compatible with any EXO sonde - Wide range Sensor reads from 0-4000 FNU - Incorporates wet-mate connector and welded titanium housing	\$1,845.00	15.00%	\$1,568.25	3	\$4,704.75
4	599103-01	EXO Total Algae - PE Sensor, Ti - Optimized for saltwater use - Phycoerythrin - Includes chlorophyll and blue green algae sensors in a single sensor - Incorporates wet-mate connector and sealed, welded titanium design	\$3,500.00	15.00%	\$2,975.00	3	\$8,925.00
						Subtotal	\$31,474.65

YSI 6600 Sensors (Turbidity and CT)

2	606136	6136 Turbidity Probe (Nephelometric) - 0-1000 NTU, 2% or 0.3 NTU - Resolution: 0.1 NTU	\$2,175.00	15.00%	\$1,848.75	1	\$1,848.75
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#	Part Number	Description	List Price	Discount	Net Price	Qty	Ext. Price
1	006560	6560 Conductivity/Temperature Field-replaceable 6-Series Probe Conductivity: Range: 0 - 100 mS/cm Resolution: 0.001 or 0.1 ms/cm Accuracy: 0.5% of reading Temperature: Range: -5 to 60 deg C Resolution: 0.01 deg C Accuracy: 0.15 deg C	\$775.00	15.00%	\$658.75	1	\$658.75

Appendix E. KWWQ Project Budget with source information on d. Equipment and e. Materials and Supplies

d. Equipment	-		-		
YSI EXO Sonde (100 m depth; 4 ports)	4	sondes	\$ 4,249.15	\$ 16,996.60	See YSI Quote (Appendix A)
IWER 2 Upgrade	1	unit	\$ 85,819.00	\$ 85,819.00	See YSI Quote (Appendix A)
e. Materials and Supplies					
YSI EXO Optical DO Sensor	6	probe	\$ 1,699.15	\$ 10,194.90	See YSI Quote (Appendix A)
YSI EXO Turbidity Sensor	6	probe	\$ 1,568.25	\$ 9,409.50	See YSI Quote (Appendix A)
YSI EXO Total Algae Sensor	6	probe	\$ 2,975.00	\$ 17,850.00	See YSI Quote (Appendix A)
YSI EXO replacement sensor kit	2	kits	\$ 69.00	\$ 138.00	https://www.ysi.com/accessory/id-599469/exo-replacement-sensor-tool--magnet-kit
YSI EXO sensor cleaning brush	5	brush	\$ 12.00	\$ 60.00	https://www.ysi.com/accessory/id-599470/exo-conductivity--temperature-sensor-cleaning-brush
Hydrogen Sulfide (H ₂ S) test strips	6	packs	\$ 28.85	\$ 173.10	https://www.cleanwaterstore.com/hydrogen-sulfide-test-kits/hydrogen-sulfide-test-kit-low-range.html?matchtype=b&network=g&device=c&keyword=&campaign=8077533048&adgroup=83465604197&ad_id=396481862628&keyword=&vsrfdom=wordstream&keyword_session_id=vt~ adtwords kt~ mt~ ta~396481862628&gclid=CjwKCAJwrusHBtEiwA qCptlsCt3k7q170JZi89zPGHzylw247Is6ZXpe601weL8BGhwXMc8hHRocYcQAvD BwE
Turbidity calibration std. (10 NTU)	24	liter	\$ 130.00	\$ 3,120.00	https://www.thomassci.com/Chemicals-Q-through-Z-StandardsStandards-N-through-T-Standards-T/ /AMCO-Clear-Turbidity-Standard-10-NTU-for-LaMotte-2020-Instruments1?q=Lamotte%20Turbidity%20Standard
YSI 6600 CTD probes	1	probe	\$ 782.00	\$ 782.00	See YSI Quote (Appendix A)
YSI CTD Calibration solution (58K µS/cm)	2	5 gal	\$ 130.00	\$ 260.00	https://www.omega.com/en-us/calibration/calibration-accessories/calibration-solutions/cds-series/p/CDSA-45000
YSI 6600 turbidity probes	1	probe	\$ 1,848.75	\$ 1,848.75	See YSI Quote (Appendix A)
YSI 6600 dissolved oxygen (DO) probes	1	unit	\$ 2,125.00	\$ 2,125.00	See YSI Quote (Appendix A) https://www.amazon.com/Duracell-CopperTop-Batteries-recloseable-all-purpose/dp/B00164H4AI/ref=asc_df_B00164H4AI/?tag=hvprod-20&linkCode=df0&hvaidid=309776907988&hvpos=&hvnetw=g&hvrand=13042266939981876574&hypone=&hytpwo=&hqmnt=&hvdvcmdl=&hvllocint=&hvllochpy=9027239&hvtargid=pla-450092859544&psc=1
Batteries (Size D) for YSI EXO	8	8-pack	\$ 13.56	\$ 108.48	https://www.mcmaster.com/3415T72/
Batteries (Size C) for YSI 6600	50	8-pack	\$ 16.00	\$ 800.00	
Concrete	4	47 lb	\$ 12.99	\$ 51.96	https://www.acehardware.com/departments/building-supplies/concrete-cement-and-masonry/ready-mix-concrete/5359757x429=true&utm_source=google&utm_medium=organic-shopping&utm_campaign=organic-shopping
PVC, primer, and glue	-	-	-	\$ 50.00	Not available
Stainless steel chain	10	ft.	\$ 2.19	\$ 21.90	https://www.e-rigging.com/eighth-inch-stainless-steel-316-chain?utm_term=&utm_campaign=&utm_source=adwords&utm_medium=ppc&hsa_acc=7830372009&hsa_cam=12879279516&hsa_grp=122304200820&hsa_ad=517681900447&hsa_src=u&hsa_tgt=pla-1265978861714&hsa_kw=&hsa_mt=&hsa_net=adwords&hsa_ver=3&gclid=CjwKCAJws-